ULL. CORNELL UNIV. AGRIC. EXP. STA.
1897.
J.
NO 138, 1897.

**Bulletin 138. September, 1897.**

Cornell University Agricultural Experiment Station.

ITHACA, N. Y.

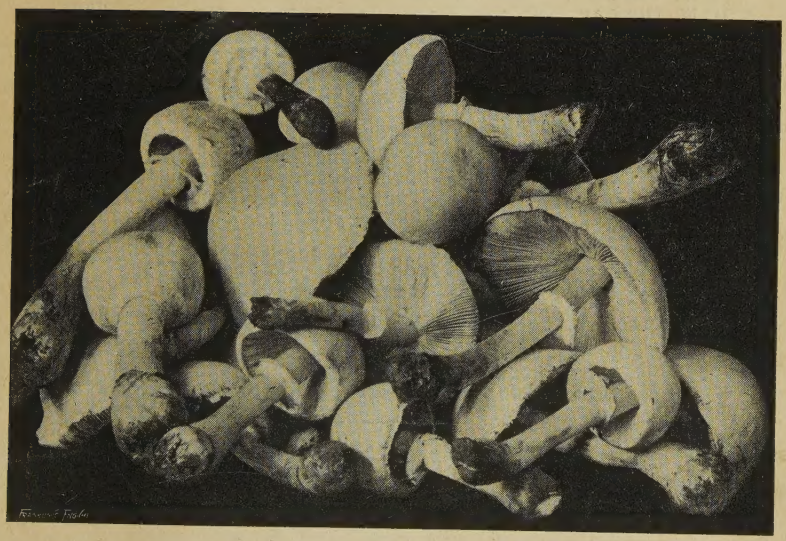
BOTANICAL DIVISION.

# STUDIES AND ILLUSTRATIONS

—OF—

# MUSHROOMS:

# I.



By GEORGE F. ATKINSON.

PUBLISHED BY THE UNIVERSITY,
ITHACA, N. Y.
1897.

COMMONWEALTH MYCOLOGICAL INSTITUTE
5 NOV 1958

# ORGANIZATION.

## BOARD OF CONTROL:

THE TRUSTEES OF THE UNIVERSITY.

### STATION COUNCIL.

President, JACOB GOULD SCHURMAN.

| | |
|---|---|
| Hon. A. D. WHITE, | Trustee of the University. |
| Hon. B. F. TRACY, | President State Agricultural Society. |
| Professor I. P. ROBERTS, | Agriculture. |
| Professor G. C. CALDWELL, | Chemistry. |
| Professor JAMES LAW, | Veterinary Science. |
| Professor J. H. COMSTOCK, | Entomology. |
| Professor L. H. BAILEY, | Horticulture. |
| Professor H. H. WING, | Dairy Husbandry. |
| Professor G. F. ATKINSON, | Botany. |
| M. V. SLINGERLAND, | Entomology. |
| G. W. CAVANAUGH, | Chemistry. |
| L. A. CLINTON, | Agriculture. |
| B. M. DUGGAR, | Botany. |

### OFFICERS OF THE STATION.

| | |
|---|---|
| I. P. ROBERTS, | Director. |
| E. L. WILLIAMS, | Treasurer. |
| EDWARD A. BUTLER, | Clerk. |

In pursuance of the provisions of Chapter 128 of the Laws of 1897, the following persons have been appointed investigators and instructors in the College of Agriculture of Cornell University to serve throughout the state according to the needs of the several localities for a portion or all of the year.

| | | |
|---|---|---|
| J. W. SPENCER, | M. V. SLINGERLAND, | A. L. KNISLEY, |
| G. T. POWELL, | B. M. DUGGAR, | C. E. HUNN, |
| J. L. STONE, | H. B. CANNON, Chief Clerk. | |

Office of the Director, 20 Morrill Hall.

The regular bulletins of the Station are sent free to all who request them.

## BULLETINS OF 1897.

124. The Pistol-Case-Bearer in western New York.
125. A Disease of Currant Canes.
126. The Currant-Stem Girdler and The Raspberry-Cane Maggot.
127. A Second Account of Sweet Peas.
128. A Talk about Dahlias.
129. How to Conduct Field Experiments with Fertilizers.
130. Potato Culture.
131. Notes upon Plums.
132. Notes Upon Celery.
133. The Army-worm in New York.
134. Strawberries under Glass.
135. Forage Crops.
136. Chrysanthemums.
137. Agricultural Extension Work, sketch of its Origin and Progress.
138. Studies and Illustrations of Mushrooms: I.

# STUDIES AND ILLUSTRATIONS OF MUSHROOMS: No. I.

BY GEO. F. ATKINSON.

With the publication of this bulletin it is purposed to begin a series of short illustrated articles on the fleshy fungi belonging chiefly to the so-called mushroom family. While there are several thousand different species of plants belonging to this group, which are more or less striking because of size, color, or form, they seem to have attracted very little attention from people generally. There is no reason why persons who have no technical knowledge of the science of botany should not know a dozen or more of the different common species, which appear through different seasons, in the same way that they come to know some of the common birds which visit us each summer.

In cities and in the larger towns there is a growing number of persons who are able to recognize, with a fair degree of certainty, the plant which is usually understood to bear the name of "*the mushroom*," and which appears chiefly during late summer and autumn in lawns, pastures, and similar open places in fields.* This plant sometimes occurs in great abundance, and the eagerness with which it is sought, by those who know its value as a food or relish, testifies to its importance as an article of diet.

If the worth of mushrooms as food was properly appreciated, even by the inhabitants of small villages and of the country, the ability to recognize several of the common species would not be difficult to acquire by those who would give an amount of attention to the subject equal to that which they bestow upon some other natural objects.

One reason why so little is known even of the common species, is because in many neighborhoods there is no one who can recog-

*In the collection of some of the material and in making some of the photographs with which this bulletin is illustrated, I have been assisted by Mr. H. Hasselbring, a student of botany.

COMMONWEALTH MYCOLOGICAL INSTITUTE
5 NOV 1958

nize several of them, and thus impart the information concerning the kinds, and their prominent characters, to others. A slight degree of interest in these objects, with some observation as to form, the parts and the color of these fungi, with some one to whom the determination of the plant might be referred for a few times, would at length enable many persons to recognize a number of the commoner species, just as they come to recognize the more common birds. Many of us come to know the common birds from childhood without any technical knowledge of ornithology. It is by observation year after year, and association with our elders who have in a similar way come to know them, that we in turn know them.

When once there are several in a neighborhood who can distinguish a few of the commoner mushrooms, this information might be handed down to generations, so that there would be no more difficulty for those who chose to observe carefully, to learn well several of the fleshy fungi, than there would be in coming to know many of the natural objects which we learn in a similar way. One might not be able to name the technical characters of the plant, but after observing it a number of seasons, it would be known on sight, or after an examination of the several parts, when these combined would present to the mind the characters of the plant as a whole, which makes up the concept of the species in the mind of those who do not make a pretense to a study of science. In addition to this if some attention in the schools could be given to teaching the general characters of these plants (not a technical treatment), it would lay the foundation for the gradual application of this knowledge in later observations.

Another reason why so few are able to recognize no more than one, is the general impression with many persons that there are but two species of this group, the "*mushroom*" and the "*toadstool.*" That is, many persons have the impression that there is but one "mushroom," the one which is "pink underneath," while all the others are "toadstools." Still others believe that all the members of the mushroom family can be separated into two groups, mushrooms which are edible, and toadstools which are poisonous. But this is all a mistake. There is no infallible test, like the "silver-spoon" test, nor any set of characters which

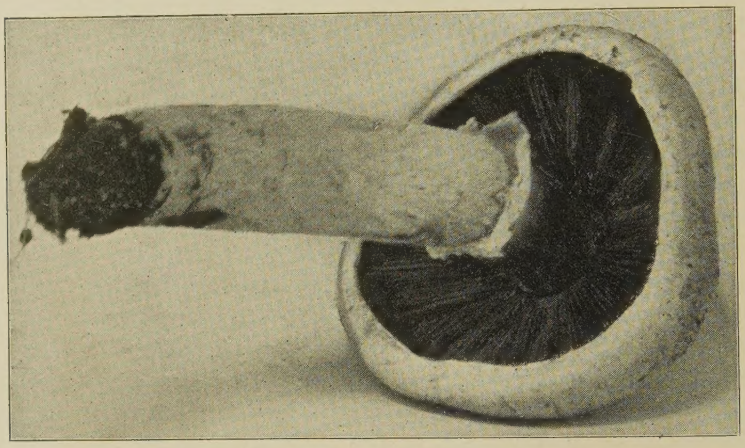
will enable one to clearly separate these plants into two such groups. There are quite a number of these plants which are edible, a few which are very poisonous, a large number which are more or less indigestible, and a still larger number which have not yet been tested, and therefore their properties are not known. Botanists do not usually recognize any distinction between mushrooms and toadstools. Either name may be applied indiscriminately to any member of the group; that is, the terms are synonymous, except that in some cases the term *mushroom* is applied to the species of commerce, and which also grows in the feral state, while the term *toadstool* is applied to all others whether edible or not. The safest way is to learn to recognize certain species even though the number be few.

So much has been written in recent years upon the value of the edible mushrooms for food and the profusion in which they sometimes occur, that there is a growing desire on the part of many people to avail themselves of this article of wholesome diet. But warned by the difficulties which beset the ordinary fungus hunter in determining the species of these plants which are to be found, as well as by the crop of fatalities recurring every season, brought forth through a mistaken mushroom identity, many are deterred from making use of the quantities of nourishing and inexpensive food growing within easy reach. When one has trained himself to recognize one or more of the common edible species with certainty, they can be collected and eaten with safety. But until this can be done it is well to give all a "wide berth," unless there is some person for "referee" whom we know to possess either the technical knowledge necessary for discrimination, or who with no technical knowledge but with long personal acquaintance with the species, knows it just as we come to know some other natural objects by careful observation. It should not be understood, however, that all who profess to be connoisseurs in the art of recognizing "toadstools" as poisonous rightly judge all the species they list among their acquaintances.

The publication in a single bulletin of careful descriptions of but a few species, with several illustrations representing the important characters and the several aspects, which the plants assume at different stages of growth, it is believed will encourage a careful study, or observation of these few, so that they will

become familiar to one and easy to detect. These few facts being assimilated and the beginner having become measurably familiar with a few forms, another pamphlet devoted to a few additional species can follow with profit.

In this bulletin only three of these fleshy fungi are illustrated and described. Two of these are edible and are very common during August and the autumn months in lawns, pastures, and



87. *Agaricus campestris. View of under side showing stem, annulus, gills and margin of pileus.*

similar open places. The third one is a *deadly poisonous* one, and is here illustrated and described, not only because a majority of the fatalities from "mushroom-eating" are probably chargeable to its seductive appearance and virulent properties, but also because it is perhaps sometimes mistaken by the novice for the common mushroom.

## THE COMMON MUSHROOM.

### (*Agaricus campestris* L.)

Figure 87 is from a photograph of a specimen of the common mushroom (or pratelle) which has been pulled and is lying on the table. The parts are easily recognized and named. The stem (sometimes called the stipe) is cylindrical, or tapers a little toward the lower

end. Near its upper end is a sort of a collar, usually termed a "ring" (or technically an *annulus*), which encircles it. This ring is very delicate in this plant, is white like the stem, of a very thin, satiny texture, and more or less ragged on the edge.

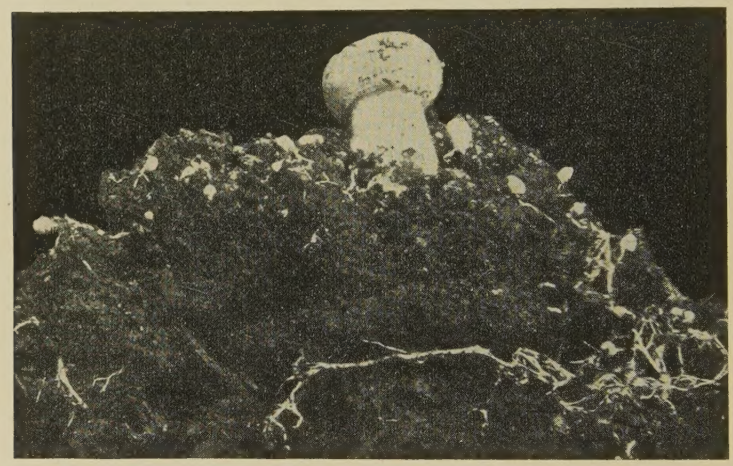
88. *Agaricus campestris. "Buttons" peeping through the sod. Some spawn at the left lower corner. Soil removed from front.*

The more or less circular expanded disk into which the stem fits is called the "cap" (technically the *pileus* which is the latin for cap). The upper portion, of which we can only see the margin in this figure, is convex (see figure 94). The surface is usually white, though sometimes brownish, and usually is covered by a thin layer of very delicate threads, while the flesh or inner portion is more compact, and is white also.

On the under side of the cap are numerous thin plates or "gills" (lamellæ), which radiate from near the stem to the margin of the cap. These are shown in figure 96 as fine radiating

lines. They do not quite reach the stem, or, when they do they are not attached to it. When the plant is very young the gills are first white, but soon become a bright pink color, and in age change to a dark brown. The substance of the stem is less compact at the center, but the stem is not really hollow, though in some instances there are slight indications of it.

The parts of the common mushroom, then, are *cap* (*pileus*) *gills* (*lamellæ*) *stem* (*stipe*), *ring* (*annulus*). We must bear in mind, however, that there are many other plants which possess just these same parts, but that they can be distinguished by the

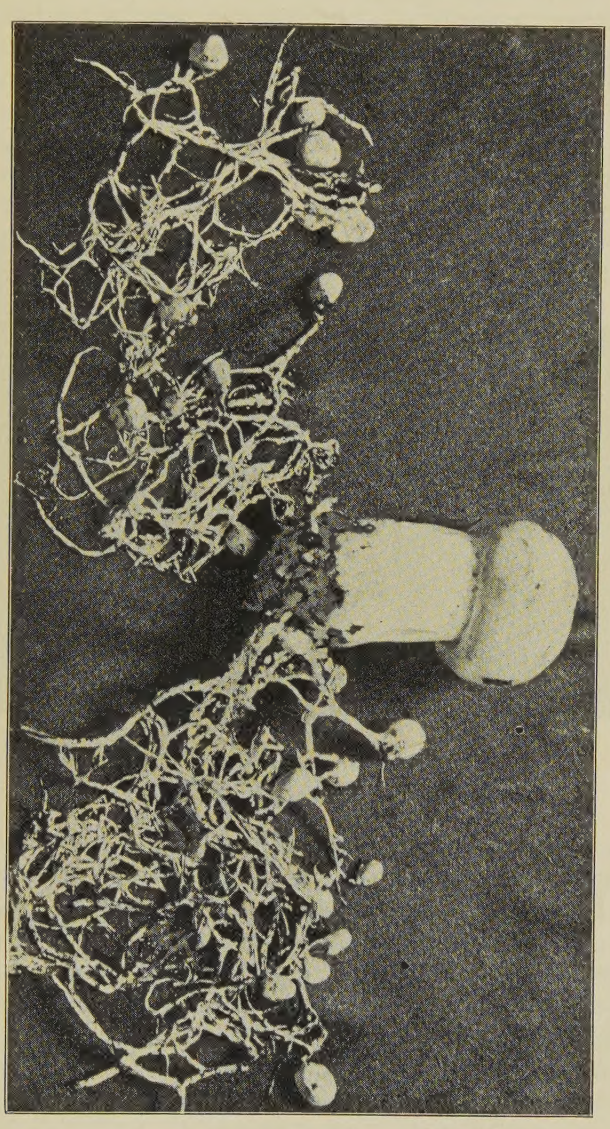


89. *Agaricus campestris. Soil removed to show large "button," and numerous small "buttons" attached to the "spawn" or strands of mycelium.*

color, form, texture, etc., of the parts. Before examining the structure of the mushroom more closely we may enquire into its history. I mean its life history; how it grows from a bit of white stuff to the size and form shown in the figure.

If we turn to figure 88 we see some quite small plants of the common mushroom, which are just peeping through the sod, and are lifting their caps among the clover and blades of grass. The earth was removed from one side before the photograph was taken, so that the short stems in the soil are laid bare. At this

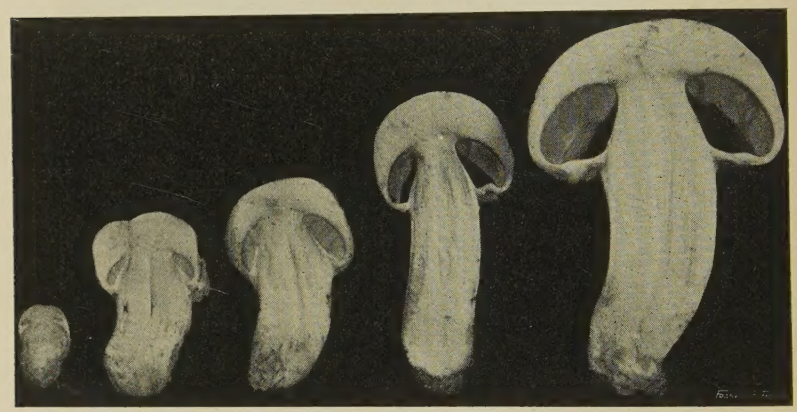
age the plant is popularly called a "button," because of its



90. *Agaricus campestris. Soil washed from "spawn" and "buttons," showing the minute young "buttons" attached to the strands of mycelium.*

form. Two quite small "buttons" still underneath the sod have been bared by the removal of the earth. At the left lower

corner of the picture are some small white bits of mushroom stuff yet "unformed." This is known popularly as the "*spawn.*" In another photograph (figure 89) this "spawn" is better shown. This has also been uncovered. Here the spawn is shown to consist of rather coarse whitish strands, or cords. One large button is present, and scattered on either side are several minute rounded white masses. These are miniature buttons, and are very young. Some of them can be seen attached to the strands of spawn. Figure 90 is from a photograph of the same group, a little enlarged, after the soil has been washed away from the



91. *Agaricus campestris. Sections of "buttons" of different sizes, showing formation of gills and veil covering them.*

spawn and the buttons. Here the connection of the very young buttons with the cords of spawn can be very clearly seen. These strands or cords are made up of numerous minute whitish threads, known to botanists as *mycelium.* In the group of fungi to which the mushroom belongs, the mycelial threads are often interwoven into such strands in somewhat the same way as fibres are woven into cords or ropes, though not in such regular fashion, and of course they grow in this form. They are often spoken of as cords or strands* of mycelium. In the soil the mycelium grows and forms new strands, obtaining its nutriment from the decaying humus and other vegetable matter.

* The term *rhizomorph* is also applied to these strands of mycelium.

At certain points on the strands the mycelium grows to form these rounded bodies known as buttons. At first they are of the size of pin heads, and soon increase to the size of bird shot, then peas, when a minute stem begins to appear with the button growing on its free end. This increase in size as well as the increase in the length of the stem lifts its head and the upper part of the stem from the ground, and it rapidly expands into

92. *Agaricus campestris. Nearly mature plants, showing veil still stretched across the gill cavity.*

the mature mushroom. If we split several of these buttons of different sizes down through the cap and the stem, we shall see the curious way in which the gills and the ring are formed. The photograph shown in figure 91 represents five of these stages. In the smaller ones the young gills in the sections resemble two eyelets. These have been covered over on the outside by the mycelium growing downward from the cap, and upward from the stem, the ends of the thread interlacing to form a veil which extends all around the stem covering the constricted portion at the junction of the stem with the button. If we cut across the button at this point the gills would show as a ring with the veil outside.

As the plant grows all these parts increase in size, the gills extending downward by the growth of the mycelium in radiating lines to form the plates. As the cap expands the veil is stretched and a cavity appears between the free edges of the gills and the veil. If we now look at figure 92, which is from a photograph of the underside of two nearly mature plants, we can see the veil stretched over the gills from the margin of the pileus to the stem. Here we can see how delicate the texture of the veil is, and how easily it is torn. During these stages the gills are pink in color except in the very youngest, when

93. *Agaricus campestris. Under view of two plants just after rupture of the veil, fragments of the latter clinging both to margin of pileus and to stem.*

they are white, unless by some accident the plant becomes old before the veil breaks. The cap now expands more and more, and the veil is ruptured as shown in figures 93 and 94. In both of these photographs the fragments of the veil are shown clinging partly to the stem, and partly to the margin of the pileus where the dripping tender fibrils lend a wierd aspect to the spectre-like plant as it lifts its head from the sod at night.

Because of the very delicate and fragile character of the veil, it does not in many cases remain clinging to the stem as a complete ring, and it is also in some cases quite evanescent. In figure 87 the ring is well formed. In figure 94, where the photograph was taken soon after the rupture of the veil, the edge of the ring has a tendency to be double where the threads break away from the inner and outer edges of the cap. In some other mushrooms this double character of the ring is quite pronounced, but here it is quite rare.

94. *Agaricus campestris. Plant in natural position just after rupture of veil, showing tendency to double annulus on the stem. Portions of the veil also dripping from margin of pileus.*

95. *Agaricus campestris. Plant showing loose fibrils on surface of pileus drawn into triangular scales.*

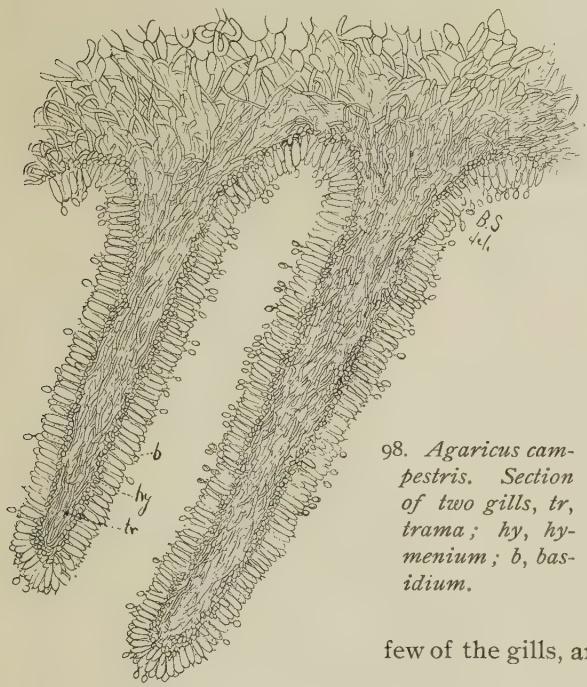
Sometimes the fibrils on the surface of the pileus are drawn into triangular patches which point outward, as shown in Fig. 95. This gives a scaly appearance to the surface of the pileus. While in the ordinary form of this mushroom, the surface of the cap is white, often the fibrils on the surface are brownish. In one form of the plant the triangular scales are dark brown, and give it a quite different aspect. This dark scaly form sometimes appears early in the spring.

If we note the position of the gills carefully, as we can by referring to the photograph (represented in Fig. 96) of the underside of the pileus, it will be seen that they do not quite reach the stem and are rounded at the inner end. They are thus only attached by their upper edges to the under surface of the pileus. Between the longer ones are shorter ones which reach, some only a little distance from the margin of the pileus, while others reach half or two-thirds the way to the stem. The space is thus used to good purpose, and the entire under surface of the pileus is crowded with these gills or lamellæ.

96. *Agaricus campestris. View of underside of pileus, showing arrangement of gills.*

The shape of the gills as well as their position can be well seen in Fig. 97, which is a photograph of a longitidunal section of a mature plant. On the right is represented an entire or long gill, which reminds one somewhat of the blade of a knife. On the left are represented two of the short gills which lie in front of one of the long ones. The surface of these gills forms what is termed the fruiting

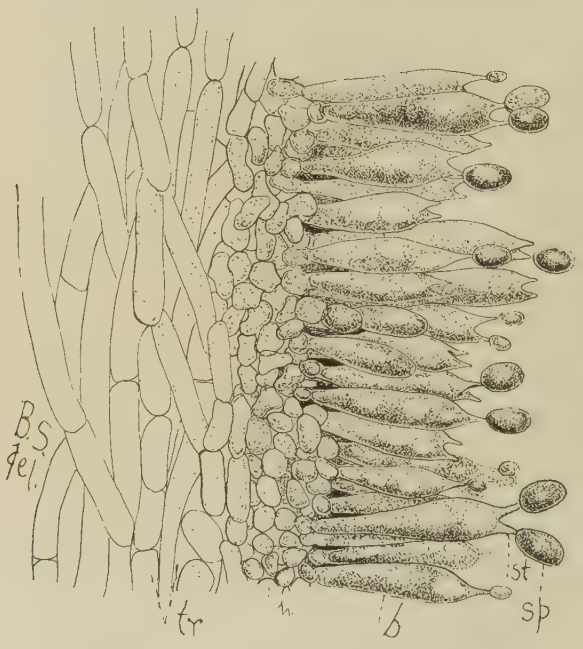
97. *Agaricus campestris. Longitudinal section through stem and pileus: a, pileus; b, portion of veil on margin of pileus; c, gill; f, fragment of annulus; e, stipe.*




98. *Agaricus campestris. Section of two gills, tr, trama; hy, hymenium; b, basidium.*

surface of the mushroom, or *hymenium*. The structure of the gill is quite specialized, and here we find parts which are characteristic of the great group of plants to which the mushroom belongs. If we cut very thin slices or sections across a few of the gills, and mount them

in water under a thin cover glass for examination with the microscope, we shall see revealed these peculiarities. Fig. 98 represents such a section of two gills. We see here that even this part of the plant is largely made up of fine threads of mycelium closely interlaced and woven together. Through the center of the gills the mycelium continues down from that of the pileus. This middle portion of the gill is termed the *trama*. Just outside of this, on either side, is a layer several cells deep of short cells termed the *hymenium*. From the cells of the hymenium are borne the club-shaped bodies which stand closely parallel in a layer on each surface of the gill. Each one of these club-shaped cells is termed a *basidium* (the latin word for club). Each basidium bears at its free extremity two slender processes which lend to the basidium a forked appearance. Each one of these processes is termed a *sterigma** (plural, sterigmata). Each sterigma bears a spore, which is a nearly rounded or oval body, so that each basidium in the common mushroom (Agaricus campestris) bears two sterigmata and two spores, while in a majority of the members of the group the basidia bear four sterigmata and four spores.




99. *Agaricus campestris. Portion of gill in section; tr., trama; hy., hymenium; b., basidium; st., sterigma; sp., spore.*

* Pronounced ster-ig′-ma; ster-ig′-ma-ta. Figs. 98 and 99 were drawn from nature by Dr. Bertha Stoneman.

At maturity these spores easily fall away from these little forked processes (sterigmata) and give a dark brown coating to the objects on which they fall. The spores are purple brown in color, and as they mature their number on the surface of the gills accounts for the dark brown color of the latter. One can obtain what is sometimes called a "spore-print" of the under surface of the mushroom, or arrangement of the gills, by cutting

100. *Agaricus campestris. Spore print.*

off the stem and placing the pileus on white paper for a few hours. It should be placed where there are no drafts of air and covered with a bell jar or other closely fitting vessel to avoid the shifting currents of air, since the spores are so light they would not fall perpendicularly, but drift and thus confuse the print. A photograph of such a spore print of Agaricus campestris is shown in Fig. 100, the dark lines representing the long heaps of spores where they fell from the surfaces of the gills.

## BRIEF DESCRIPTION OF AGARICUS CAMPESTRIS.

The common mushroom (Agaricus campestris) grows in lawns, pastures and similar places. It averages 5–8 cm. (2–3 inches) in height, the pileus being 5–12 cm. in diameter.

*Pileus.*—The cap or pileus is convex or more or less expanded, the surface being nearly smooth, or more or less silky hairy, these fibrils sometimes being collected into triangular scales. The color of the surface is usually white, but varies to light brown, while the flesh is white.

*Gills.*—When the plant is very young the gills are first white, but soon become pink, and later purple brown or dark brown from the numerous purple colored spores on the surface. The gills are free from the stem, and rounded on their inner ends.

*Veil and Annulus.*—The veil is thin, white, silky and very frail. As the pileus expands the veil is stretched and finally torn, when it clings as a thin collar or ring (annulus) around the stem, or fragments dangle from the margin of the pileus. As the plant becomes old, the annulus shrivels up and becomes inconspicuous.

*Stem or Stipe*—The stem is white, nearly cylindrical, or slightly tapering at the lower end. It varies from 3–8 cm. long and 1–2 cm. in diameter. The flesh is solid, though less firm at the center.

## GROWTH OF THE MUSHROOM.

The mycelium in the form of delicate threads or stouter strands (called spawn) lives in the soil, absorbing in solution certain of the substances of decaying vegetable matter, which it appropriates for growth and increase. It lives here for several months, or in some cases for years, before developing the fruiting portion which is the "mushroom." This first appears as a minute rounded mass on the strands of mycelium. It grows in size to form a "button" with a stem. The young gills are formed by the mycelium growing downward in radiating ridges from the under side of the margin of the button, the gills at first being covered by a delicate veil of interlacing threads. As the pileus expands it bursts through the sod, ruptures the veil, when the characters of the fully formed mushroom appear.

101. *Lepiota naucina*. Plants natural size in lawn.

102. *Lepiota naucina. Plants natural size in four stages; showing formation of annulus from veil.*

## Lepiota naucina Fr.

The next mushroom, or toadstool, described here is one which occurs during the same season as the Agaricus campestris (common mushroom), and in similar localities i. e. in lawns, pastures, etc. It is known as *Lepiota naucina*, the short stemmed parasol, or smooth Lepiota. Because of this similar seasonal and local occurrence it might at first be taken for the Agaricus campestris, especially since the plant is about the same size, is usually white,

103. *Lepiota naucina. Section of three plants of different ages.*

or light tan, and possesses an annulus. The gills, however, are white from the youngest stages to maturity, only becoming pinkish when very old, and drying a light brown or dirty pink.

A photograph of this plant as it occurs in lawns is represented in figure 101. On looking at the gills of a freshly growing plant one would readily distinguish it from Agaricus campestris, because of their white color. The spores of this plant are white, as one can readily determine by making a spore print as shown

in figure 105. The color of the spores is one of the most constant characters which the members of the mushroom family possess, and in studying these plants some of the spores should be caught on white paper for the purpose of determing their color. Figure 102 represents four different sizes and stages of this Lepiota. In the plant at the left the veil still covers the gills. In the next one it has broken away from the margin of the pileus and forms a collar around the stem. In the third the pileus is still more expanded. In figure 103 are shown sections of three plants of different ages. We see here that the gills are free from the stem. The general characters, then, with the exception of the color of the spores, are the same as those of the Agaricus campestris.

104. *Lepiota naucina. View of gills on under surface of pileus.*

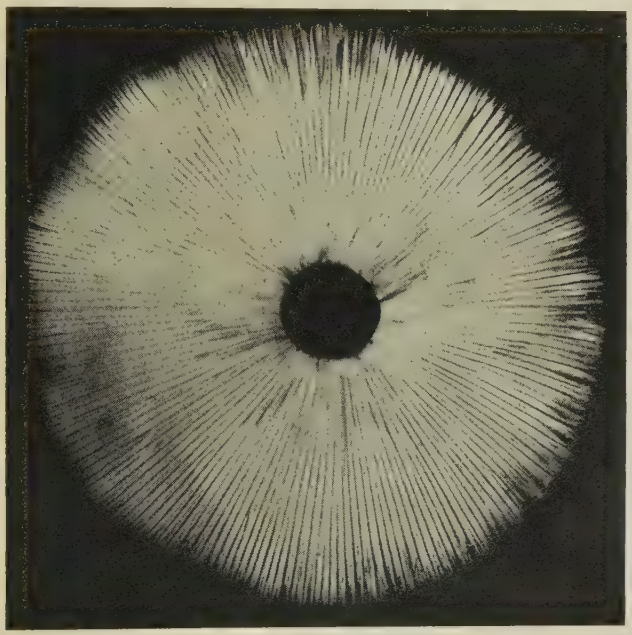
This distinguishing feature, the different color of the spores, is regarded as such an important one that it is used to separate genera, and so this plant is placed in the genus* Lepiota instead of in Agaricus, though all the other generic characters are identical.

A few specific points might be described more in detail. The pileus is usually quite smooth, though in some specimens the surface shows numerous very fine cracks, which give it a granular appearance. The pileus is usually very symmetrical,

* Subgenus according to some.

rounded when young and strongly convex when mature. The flesh is soft and white but remains much firmer in age, and when picked, than does that of Agaricus campestris.

The veil is also firmer than in the case of Agaricus campestris. It separates cleanly from the margin of the pileus, as well as from the stem, so that it forms a perfect collar or ring, which in some cases may be moved on the stem. The lines of separation and the firm veil are clearly shown in the plant at the left hand in figure 102. In old specimens the ring sometimes is torn, and may disappear.



105. *Lepiota naucina. Spore print.*

The stem is nearly cylindrical, 5–10 cm (2-4 inches) long and ¾-1½ cm in diameter, and is slightly enlarged or bulbous below. It is nearly hollow, as shown in figure 103, though this cylindrical space is usually stuffed with loose cottony threads.

The Lepiota naucina is an edible species, and is valued as highly as the Agaricus campestris by many who have eaten it.

Like the Agaricus campestris it is also an European species, though the descriptions in European botanical works are quite meager, and much confusion exists in reference to the shape of the spores. The spores of the European specimens are usually described as "round," though Mr. Massee in his British fungus Flora describes them as subrotund. This confusion regarding the shape of the spores has led to the belief on the part of some in America that our plant is different from the European one, for the spores in our plant are elliptical or oval, not rotund. For this reason the plant in America has been called by some *Lepiota naucinoides*. After careful study and observation of our plant, and by comparison with illustrations and descriptions of the European species, the conclusion is irresistible that the two are identical. In order to have our plant compared with the European one the writer sent some specimens to Mr. George Massee, of the Kew Herbarium, London, England. The director of the Herbarium has kindly replied that our plant is "*Lepiota naucina, typical.*"

### AMANITA PHALLOIDES FR.

(*The deadly amanita.*)

The third and last plant described here is one of the "deadly" amanitas, the *Amanita phalloides*. It is mentioned here not only because it is probably responsible for a majority of the deaths from eating mushrooms, but because by the novice it might well be taken for either the Agaricus campestris or Lepiota naucina, especially the latter. It usually occurs in woods, while the two other plants here described occur in open places. The amanita phalloides sometimes occurs in borders of lawns near woods. I have this year in the early part of September found four or five specimens of this deadly amanita in the border of one of the lawns on the campus of Cornell University.

One form of the plant is represented from a photograph in figure 106. It is pure white and possesses an annulus or collar, *but what is most important the base of the stem rests in a cup-like envelope called the volva.** In this specimen the margin of the

* Popularly termed the "poison-cup," "death-cup," etc.

volva is cleft into three parts which are somewhat spreading. This specimen was collected in a beech woods along a damp ravine in the month of July. The veil has separated by an even line from the margin of the pileus and hangs as an annulus in the form of a broad collar from near the upper end of the stem.

The pileus in this form is smooth, viscid to the touch, and pure white, as is also the annulus, stem and volva, though the latter is soiled by particles of earth. The stem is nearly cylindrical, tapering slightly from the bulbous base. It is hollow, or stuffed with cottony mycelial threads. The gills are usually pure white, even in age, and are nearly free from the stem. When decaying the plant emits a very disagreeable odor.

106. — *Amanita phalloides. White form, showing pileus, stipe, annulus and volva.*

Because this plant is sometimes found in lawns and in fields bordering on the woods great care should be exercised in the collection of the Agaricus campestris, and especially of the Lepiota naucina, to be certain that a *volva* is not present on the lower end of the stem. Until one is certain he knows the plant he is collecting, the plants should not be picked by simply taking hold of the pileus, but the stem should be carefully dug up. In the case of some plants of Amanita phalloides which I found in a lawn the stem was about 7 cm (nearly 3 inches) deep in the ground, so

that by simply picking the plant by the cap, the most important character, the *volva*, would be lost, and by a novice the plant might be taken for the Lepiota naucina. Some of the specimens of Amanita phalloides which I have collected this summer might even be taken by a novice for the Agaricus campestris if the volva were not obtained. In some of the young specimens the gills were *decidedly pink*, so much so that several persons who saw the plants remarked on the pink color of the gills and they were not aware of the significance of this fact. It should be stated, however, that the pink color of the gills in these young specimens of Amanita phalloides is not nearly so deep as the pink color of the gills of Agaricus campestris.

FIG 107. *Amanita phalloides. Plant turned to one side after having been placed in a horizontal position by the directive force of gravity.*

A pure white plant very closely related to this white form of Amanita phalloides, which occurs in the spring or early summer is considered by some to be a distinct species, called *Amanita verna*. These pure white forms of some amanitas, because of their deadly poisonous property, are sometimes called the "destroying angel."

Shortly after the pileus of these plants breaks through the volva, and the stem is elongating, they are very sensitive to the directive influence which the earth, or gravity, exerts on the

growth of many plants. One of the reasons why the plant grows in an upright position is that this influence directs it away from the earth. This is easily observed in placing young and

108. *Amanita phalloides. View of under side of pileus, showing form and position of annulus and volva.*

109. *Amanita phalloides. Another view of Fig. 22.*

rapidly growing specimens in a horizontal position. In a few hours the stem end near the pileus begins to turn upward, and the plant has taken the form shown in figure 107. This plant was lying on its side for only about one or two hours, and the stimulus

which it received in this position during the short period caused it to turn after it had been stood upright again. A view of the underside of this same plant is shown in figure 108, and in figure 109 a diagonal view, which represents well the form and attachment of the annulus to the stem.

Other forms of the Amanita phalloides occur in which the pileus is yellow, or greenish, instead of white, and sometimes bits of the *volva* remain adherent to the surface of the pileus in

108. *Agaricus campestris.*

the form of whitish patches. There are other species of the genus Amanita which cannot be discussed in this bulletin, but will be illustrated in a future one.

Those who are not familiar with the three plants here illustrated, and who desire to be able to recognize them, are advised to search the pastures, etc., for the Agaricus campestris and Lepiota naucina, and also the damp woods for the Amanita phalloides, and to compare the plants found there with these descriptions. In this way familiarity with the species may be acquired which will serve as a means of determining them in the future.

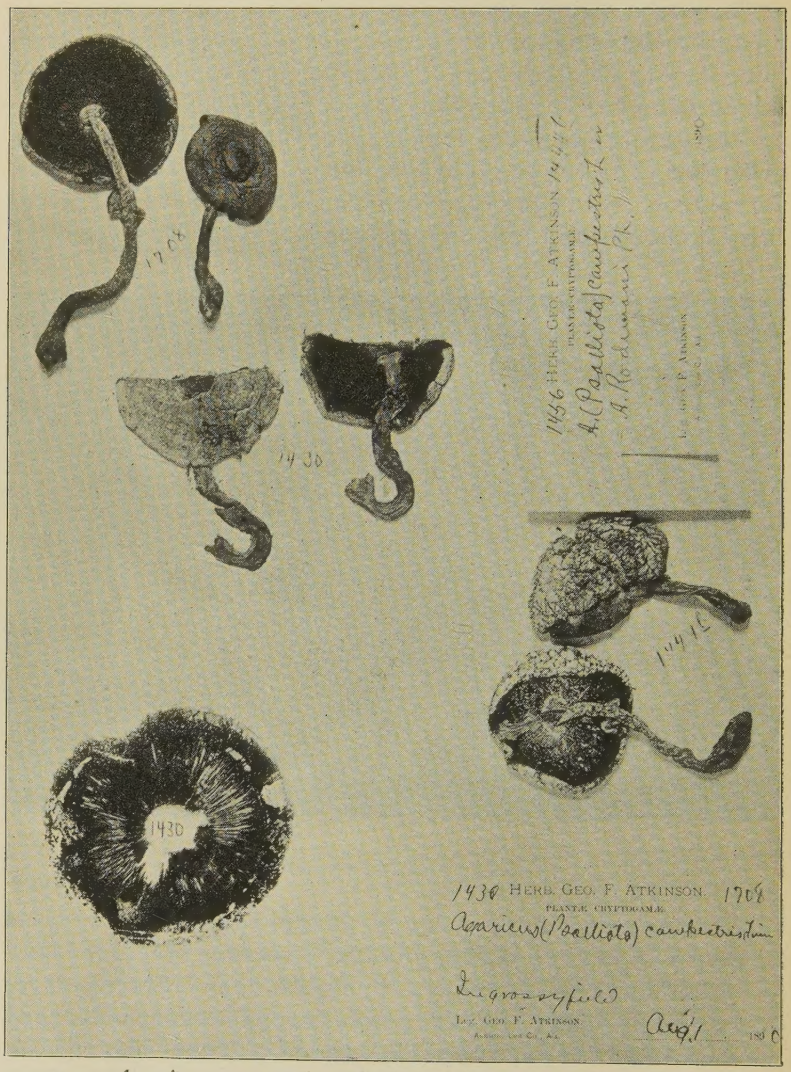
The two former species often occur in such abundance during the autumn that basketsful of them can easily be gathered.

Those who wish to preserve these plants in the herbarium, or for future determination if there is not an opportunity to determine them in the fresh state, should dry them carefully after first taking full notes on form, color, size, texture, position, etc., of the various parts of the plant. Full directions for taking careful notes, or for drying cannot be given here, but may be attempted at some future time. The Agaricus campestris and Lepiota naucina can be dried in the sun, and may then be kept in boxes. Or when mois-

111. *Lepiota naucina.*

tened again a little by dew, may be pressed lightly between sheets of absorbent paper, and then glued to herbarium sheets or folded in paper packets as shown in figure 112. Specimens of Amanita phalloides contain proportionately more water and consequently shrivel more in drying. They are apt to decay before they can be dried in the sun, except in very bright weather. Artificial heat can be used but this causes the plants to shrivel still more unless the process of drying is very slowly accomplished. In this case they should be placed over

the source of heat where currents of warm air are rising and then dried very slowly. In the case of the large and watery ones




112. *Agaricus campestris. Photograph of sheet from herbarium.*

some cut the plants down into two halves through the stem, then cut out the inner fleshy part of the pileus and stem, and then

placing the inner faces on an herbarium sheet, dry under pressure by hot driers which should be changed frequently. This process preserves well the external form and characters where properly done. If this rule is followed other plants should be preserved whole. In order to have a record of the characters, however, careful notes on all the characters should be taken while the plants are fresh, since so many of the important ones are evanescent and disappear in drying. The notes can be supplemented by pencil sketches or even by photographs if the collector so desires. A spore print should also be preserved for a record of the color of the spores, since one cannot use the color of the gills in all cases to determine that of the spores, and a few spores under the microscope do not in many cases give the tint which a mass of spores show, and which is very important to know. Some liquid fixative like gum-arabic should be spread on the portion of the white paper covered by the pileus previous to taking the spore print so that the spores will adhere well to the paper; or they may be later fixed by using material like Rouget's fixative with an atomizer, though with this latter treatment, the figure of the print is apt to be disturbed somewhat.

In the preparation of mushrooms for the table, information may be obtained from other sources if it is not already at hand, since we cannot here enter into a discussion of the culinary treatment. But as a matter of course all wormy and very old specimens should be discarded.

In communities where there is a desire to become acquainted with the common fleshy fungi, those interested might combine to form a "mycological club." A number of persons thus associated together might purchase a small reference library to be kept in a club room, at a trifling cost to each member. Here specimens could be brought, the literature and illustrations compared and an exchange of opinions between the members on the various plants would assist in a more ready determination of the plant, and in the acquisition of useful information as to occurrence, habits of growth, etc. Some few in such a community would become more expert than others, and could at length be regarded as "specialists" to whom more doubtful matters could be referred, or who themselves in doubtful cases could consult by

correspondence with some one possessing greater opportunity at some botanical center. Such a club would undoubtedly become interested in other nature subjects which would afford both pleasure and profit.

A few books and pamphlets which might be obtained to start such a reference library are enumerated below with the price. Some of the larger useful books are not here mentioned because of the cost.

Farlow, W. G. Notes for Mushroom-Eaters (published in *Garden and Forest*, January and February, 1894). Published also as a separate. 25 cts.

Gibson, W. H. Our Edible Toadstools and Mushrooms. $7.50.

Massee, G. British Fungus Flora. 4 vols. $2.00 each.

Peck, C. H. Mushrooms and their Use. 50 cents.

A recent work by Dr. Peck, with many colored illustrations, published in the 48th annual report of the N. Y. state museum of natural history, and issued as a separate, has been exhausted, but a new edition is being published. This can be obtained when issued for about one dollar by applying to S. B. Griswold, State Library, Albany, N. Y.

A Text Book of British Fungi, by Delisle Hay, contains a fairly good glossary of terms used in descriptive works, and also an analytical key arranged after W. G. Smith. A chart of colors which is useful in taking notes can be found in Saccardo's Chromotaxia, 60 cents. This latter as well as Dr. Peck's "Mushrooms and their Use," can be obtained from the Cambridge Botanical Supply Co., Cambridge, Mass. This pamphlet contains also a list of other works on fungi.

GEO. F. ATKINSON.